Plasma-Assisted Combustor Dynamics Control

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Abstract:

The key, central objective of this proposal is to demonstrate the effectiveness of implementing a plasma discharge to improve combustor dynamics and flame stability at realistic gas turbine conditions.

The methods/techniques proposed to accomplish this above stated objective during Phase II are two-fold. While nanosecond pulsed, low temperature plasma discharges will still be employed based on demonstrated effectiveness with minimal penalty of NOX production, the key differences from the Phase I effort are as follows. First, the regimes of flow speed (up to ~ 100 m/s), inlet temperature (up to ~ 1150F), and pressure (up to ~ 250 psi) will be significantly elevated in comparison with the ambient conditions of Phase I. Second, more realistic injector geometries and liquid fuel will be investigated.

We believe that the work being proposed herein offers high significance to NASA, not only for the specific objectives of this solicitation, but also for other NASA problems and programs. Under Phase I, UTRC successfully demonstrated more than 90% pressure oscillation reduction in the presence of the plasma with minimal increase of NOX (< 0.5 EINOX) and also developed a no-time-delay control scheme. The significance of this work, but more importantly the proposed concept which will continue to be the focus during Phase II, is that it can potentially enable ultra-compact, low emission combustion with a reduced fuel staging requirement and wider operability. The Phase II study being proposed may also have a potential to change the paradigm in which combustors are designed by drastically reducing the combustor aerodynamics requirements for flame stabilization. Further, it may provide solutions for other flame stability problems, such as lean-limit enhancement.